THE SECOND BYRD ANTARCTIC EXPEDITION—BOTANY

I. Ecology and Geographical Distribution

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INTRODUCTION

The Marie Byrd Land Exploring Party of the Byrd Antarctic Expedition II returned after a three-months' intensive sledging journey to the expedition's base, Little America, in December, 1934, with an unusually large collection of mosses, lichens, and algae, native to the nunataks of that land. The location of Marie Byrd Land makes the collection of plants especially interesting, because of its high latitude, often regarded as an area beyond the limits of plant life. The collection is the largest which has been made south of the 70th parallel and includes at least seven species found by the Queen Maud Geological Party of the same expedition, three of which were growing as close as 237 miles from the South Pole at an elevation of more than 2000 feet.

The purpose of this paper is to discuss the geographic factors affecting their distribution and floristic affinities. The flora of the Antarctic is noted for its extreme paucity in forms, and the collections of specimens which have heretofore been made were in general more a matter of chance than of purposeful research and exploration.

The history of Marie Byrd Land dates from December 5, 1929, when Rear Admiral Richard E. Byrd (at that time Commander), U.S.N. retired, was leading a large American expedition to the Antarctic. During one of his historical flights along the coast to the east of his base camp, Little America, located in the Bay of Whales in the Ross Sea he discovered a land hitherto unknown and unclaimed. The British claim to the Ross Sea Dependency extends to the 150th meridian of west longitude, so

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that as he flew to the eastward from this meridian he was not only penetrating an unexplored land but an area which had not been previously claimed by any nation. Southward high elevations indicated snow-covered land, and just beyond the 150th meridian he sighted coastward rock exposures, the first he had seen since leaving the Rockefeller Mts. of King Edward VII Land, which had also been one of his discoveries earlier in the year.

As the peaks appeared on the horizon they were duly photographed and eventually located upon a reconnaissance map of the new land. The mountain systems he named the Edsel Ford Ranges, and the land was named in honor of the Commander's wife, Marie Byrd. Since conditions were impracticable for landing, field work could not be carried on within any of the mountains on the coastward end of this land to the north. Thus it remained the work of a second Antarctic expedition, again under the leadership of Admiral Byrd, in 1933–1935, to explore the new land.

Marie Byrd Land, a great triangular wedge with its apex at the South Pole and its base on the ice-guarded coast of the Pacific Ocean, is bounded on the west by the 150th meridian of west longitude and stretches eastward through twenty or more degrees of longitude. It lies almost midway along the coast between the two best-known sections of the Antarctic, Graham Land to the east, and South Victoria Land to the west. Its position, without known land bridges and facing along one of the broadest islandless sections of the Pacific Ocean, becomes more important in view of the fact that Graham Land and South Victoria Land are very different in their geological structure. Obviously they are not parts of one physiographic unit and some significant geomorphologic changes have taken place within the snow-covered expanse lying between them. Thus mid-position in the questionable area establishes the potential importance of the newly discovered coastal mountains of Marie Byrd Land.

The location of Marie Byrd Land also is of interest to botanists, for extensive collections of Antarctic mosses and lichens of the continent proper had been gathered only in Graham Land and in South Victoria Land. In the latter, certain affinities

were found to the lichens and mosses of Australia and New Zealand, while in the former some of the specimens were associated with those previously collected in South America, affinities which from their geographical location appear logical. However, the species of either region show little in common with those of the other. What characteristics of plant life might be exhibited in the land lying between these two more open sections of the Antarctic? The answer to this pertinent question became one of the major aims of the field party, part of the program of the second Byrd Antarctic expedition, which penetrated the territory on foot.

The writer was a member of the first, and of the second, Byrd Antarctic expeditions, and on both occasions was connected with the Biology Department. On the first expedition he served as nature observer in the vicinity of Bay of Whales. On the second expedition he was placed by Admiral Byrd in charge of organizing the Biology Department. Three full-time observers and one assistant formed the department, and in plans proposed it was agreed that the writer, because of his previous Antarctic experience, should be permitted to lead a small party into the coastal mountains to the east for special biological observations and reconnaissance. Admiral Byrd not only granted permission but recommended enlargement of the plans into one of the major field parties of the expedition.

Thus the Marie Byrd Land Exploring Party began. Associated with the writer on the adventure were F. Alton Wade, as Geologist, and Stevenson Corey and Olin Stancliff, as assistants and dog drivers. The party left Little America on October 14, 1934, and returned on December 29 of the same year. The men traveled on skis beside their three dog teams, later combined into two larger teams, which dragged on sledges all the equipment and food of the party.

The complete objectives of the party included: first, mapping the mountains by triangulation and solar fixes for ground control of the aerial photographic map which was to be constructed later; second, geological and glaciological study of the land; third, biological survey of the regions visited; fourth, magnetic observations wherever practical; and last, meteoro-

logical observations which would also serve by radio communications as guide to flying conditions when exploratory flights were projected eastward from Little America.

A chronological history of the trail journey is recorded elsewhere and need not be included.[1] The accompanying map shows the route taken by the party, and the following discussions include notations on the general conditions encountered. The journey was undertaken entirely in daylight, for only on nights of the first week or so did the sun dip below the horizon at midnight. Temperatures ranged from about –40° F. to 34° on extreme occasions, but averaged about zero or above during the entire journey. Aside from the loss of three dogs no casualties of serious consequence occurred.

The biological program of the party covered several distinct phases. The results of zoological observations included one new rookery of snowy petrel on Mt. Helen Washington in the Rockefeller Mts. of King Edward VII Land, and a skua gull retreat on Skua Gull Peak. The microbiological work included many aseptically-taken samples of rock, plants, snow, stagnant water, mud, etc., from which many colonies of bacteria and moulds have been separated for identification; and in samples of ice and water numerous infusoria, rotifers, water bears, etc. were collected and photographed by cinema and still micro-shots. The botanical phase of the work included the collection of mosses, lichens, and algae from as many locations as could be examined and from which specimens could be gleaned.

Plant specimens were collected by searching diligently on all exposures of rocks and in likely crevices wherever the party stopped. Typical pieces of each kind of moss or lichen were taken from each location where the form was found, and wherever practical with attached bits of the substratum the better to preserve the plant intact. In some areas density of plant life was too great to obtain more than random samples, while in other places where life was more sparse nearly every available

[1] Byrd, R. E. Discovery, the story of the second Byrd Antarctic Expedition. i–xxi, 1–405. illus. G. P. Putnam's Sons, New York, 1935.

Siple, P. A. Scout to explorer, back with Byrd in the Antarctic. i–xiv, 1–239. illus. G. P. Putnam's Sons, New York, 1936.

specimen was taken. The plants were placed in small wooden or cardboard boxes, and the more delicate specimens were individually wrapped in tissue paper. As the success of a polar trail usually depends upon concentration of the load of supplies, nearly every item at the start is reduced to a minimum to permit maximum amount of food (which determines the maximum length of stay in the field). The party had not been aware of the density of plant life, and consequently the supply of containers was scant. Less than a hundred small boxes were taken, and bags and other odd containers were borrowed from the galley equipment to help transport the unlooked-for richness of the finds. The collection was packed in a strong protective box and not disturbed to any extent until turned over to Dr. Carroll W. Dodge and to Mr. Edwin Bartram. Each box of specimens was labeled by its own serial number and by the number of the peak on which they were found, as corresponding to the survey of the unnamed mountains.

Simultaneously with the departure of the Marie Byrd Land Sledging Party to northwestern Marie Byrd Land, the Queen Maud Geological Party departed for similar reconnaissance in the mountains of southern Marie Byrd Land near the 150th meridian of west longitude between 85° and 87° of south latitude. Quin A. Blackburn, geologist, was leader of the party, ably assisted by Stuart D. L. Paine and Richard S. Russell, Jr. Although their interest lay principally in studying and mapping the geology of this region, they kept watchful eye for any plant life which might occur. It is to their credit that they engaged themselves so well in their search that they brought back at least eight different species of lichens so small as likely to have escaped any casual observer, but representing the most southerly existing flora so far recorded in the world, and indicating that these mountains support a far less luxuriant growth of plants than do the coastal ranges.

The success of the two major field parties could not have been achieved had it not been for sincere cooperation of the entire expedition. The technical staff at Little America helped in equipping the party and preparing the dogs, while supporting parties of dog teams and tractors materially aided by laying

depots of food supplies in early stages of the journeys. The Marie Byrd Land Sledging Party was particularly fortunate in having its depots laid as far as Mt. Grace McKinley and in having a thousand pounds of food laid down at that point by a Citroen tractor manned by Harold I. June, Kennett L. Rawson, and Carl O. Peterson.

PHYSICAL FACTORS AFFECTING DISTRIBUTION, AND SOME APPARENT ECOLOGICAL ADAPTATION

To understand better the conditions which permit a flora on Marie Byrd Land, it seems well to evaluate the environmental factors of the plants and to note some of their apparent adaptations to the rigorous conditions of their habitat.

Geological and glacial factors.—The mid-position of Marie Byrd Land, between Victoria Land to the west, Graham Land to the east, and the Queen Maud Mountains to the south, gave rise to most intriguing geological observations.

From rather meager data it is concluded that the sequence of geological events in the history of Marie Byrd Land was as follows: "deposition of a great series of arkosic sandstones and shales on the pre-Cambrian basement rocks, close folding of this sedimentary series accompanied by the deep-seated intrusion of acid magma, a long period of erosion, glaciation, and the extrusion of olivine basalt during the Pleistocene."[2]

The eroded coastal ranges are remnants of highly metamorphosed sediments resting as broken synclines upon massive intrusions of granites and eruptives, and show little definite relation to the Queen Maud Mountains to the south which are surmounted by lofty flat-lying beds of fossil and coal-bearing sediments. The rocks show a structural similarity to those of the Graham Land region to the east and an affinity in chemical composition to the ranges of South Victoria Land to the west but differing in most other respects from either.[3]

[2] Wade, F. Alton. Petrologic and structural relations of the Edsel Ford Range, Marie Byrd Land, to other Antarctic Mountains. Bull. Geol. Soc. America **48**: 1387–1395. *3 pl. 2 fig.* 1937.

[3] The geological references for this article have been supplied by F. Alton Wade, geologist Marie Byrd Land Sledging Party, by special notation and adaptations

The exposures along the coast appear as peaks recently emerged from the glacial ice-covering which caps the entire continent of Antarctica. Extensive areas of fracture suggest that the ice, relieved of its pressure near the coast, is dropping rapidly into the sea and exposing the coastal peaks. South of the coast the snow mantle rises until it inundates all the highest peaks and continues at an increasing elevation toward the Queen Maud Mountains which again thrust their loftier summits through the snow cover. Whether or not the land is continuous is one of the most hotly disputed questions regarding the structure of the Antarctic, and satisfactory proof remains yet to be elicited by sonic depth soundings.

The Edsel Ford Ranges of Marie Byrd Land are coastal. However, they assume the character of inland peaks because they are included within great fields of shelf and pack-ice frozen out into the ocean, and many of the peaks are 50 and 100 miles from the nearest open leads of water and hundreds of miles away from the nearest ice-free seas. The peaks have been heavily glaciated by over-riding continental ice pushed seaward from the center of the continent, as indicated by empty cirques, hanging valleys, glacial striae, and many other features of erosion and morainic deposition, now revealed above the ice. Recent retreat has lowered the ice level along the coast until the peaks have emerged as nunataks.

It is thus apparent that until recently ice covered the entire land, even eroding the highest pinnacles until no vestige of residual soil or plant life remained on them. Only the peaks are bare of ice, and support vegetation.

The accompanying table presents the petrographic description of the common rock types and mineral composition as determined by microscopic analysis. The fineness of grain of the sedimentary metamorphics has made analysis of them by this method impossible. Though chemical analyses are not yet available, description of the rocks is included.

from his doctorate thesis on the geology of Marie Byrd Land, at the Johns Hopkins University: ''Northeastern borderlands of the Ross Sea: glaciological studies in King Edward VII Land and Northwestern Marie Byrd Land.'' Geog. Rev. **27**: 584–597. *16 fig.* 1937.

CHEMICAL ANALYSIS OF SOME OF THE IGNEOUS MOUNTAINS IN THE EDSEL FORD RANGES OF MARIE BYRD LAND, COMPILED BY F. ALTON WADE

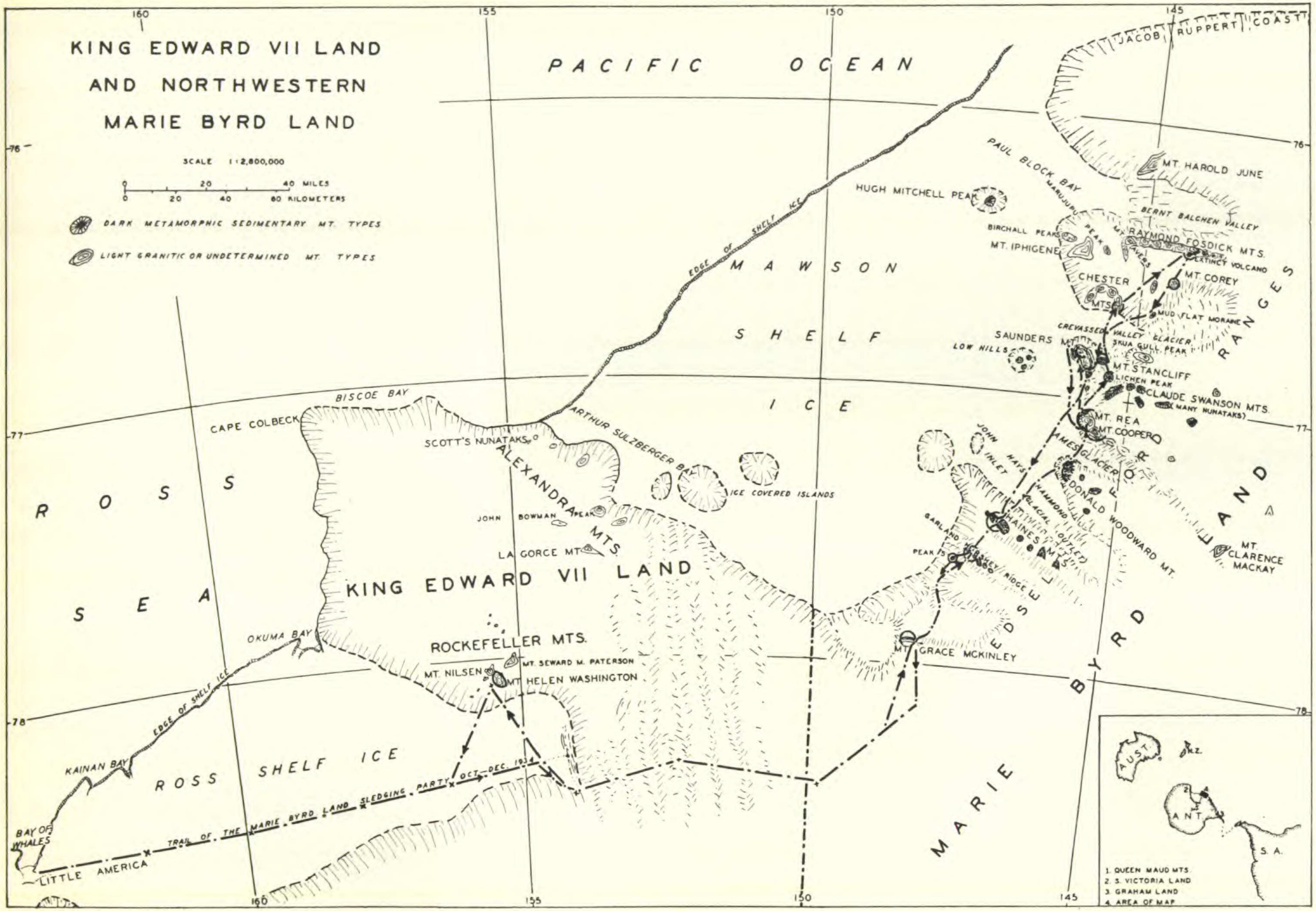
	1	2	3	4	5	6	7	8	9
SiO_2	74.	74.	41.	72.	67.	62.	66.	55.	68.
Al_2O_3	15.5	14.3	21.6	15.7	17.9	20.8	19.2	22.	17.3
K_2O	3.5	8.6		7.9	4.3	5.0	5.8	4.2	8.9
No_2O	6.7	1.2	2.6	3.1	2.7	3.4	3.1	4.1	4.0
CaO		1.4	9.5	0.42	3.6	4.2	3.5	5.6	0.4
M_8O			5.6	0.17	1.2	1.4	0.8	1.0	0.2
FeO		p*	9.0	0.17	2.6	2.5	1.4	3.2	0.3
Fe_2O_3		p	7.2		0.4	0.3		3.4	p
H_2O	0.13	0.08	2.7	0.07	0.4	0.4	0.2	0.3	0.06
P_2O_5	p*	p	p	p	p	p	p	0.6	p
CO_2			0.4		p	p			
Cl_2, F_2	p	p	p	p	p	p	p	p	p
ZrO	p	p	p	p	p	p	p	p	p

p* = present in very small amounts.

1 = Leuco-sodaclase granodiorite (gray granite), N.W. Ridge, McKinley.
2 = Leucogranite (coarse pink granite), McKinley.
3 = Porphyritic diabase (black dike), N.W. Ridge, McKinley.
4 = Leucogranite (pink granite), Rea.
5 = Granodiorite (gray granite), north peak, west side, Saunders.
6 = Granodiorite (gray granite), south peak, west side, Saunders.
7 = Sodaclase granodiorite (gray granite), S.E. exposure, Chester Mts.
8 = Granodiorite (massive central mass), Raymond Fosdick Mts. near Volcano.
9 = Leucogranite, Corey.

Several of the mountains exhibited on the surface of the rocks calcareous deposits which were collected as possible plant life, especially at Mt. Stancliff, Lichen Peak, and Skua Gull Peak, all rich in plant life.

The accompanying map portrays the general distribution of the dark metamorphic sedimentary peaks flanking the intrusive cores of contrasting light-colored granitic rock. As may be seen in the table, distribution of plant life in general seems to be a little denser on the darker mountain peaks


KING EDWARD VII LAND
AND NORTHWESTERN
MARIE BYRD LAND
SCALE 1:2,800,000
0 20 40 MILES
0 20 40 80 KILOMETERS
DARK METAMORPHIC SEDIMENTARY MT. TYPES
LIGHT GRANITIC OR UNDETERMINED MT. TYPES
PACIFIC OCEAN
JACOB RUPPERT COAST
MT. HAROLD JUNE
PAUL BLOCK BAY
BERNT BALCHEN VALLEY
HUGH MITCHELL PEAK
BIRCHALL PEAKS
MT. IPHIGENE
RAYMOND FOSDICK MTS.
EXTINCT VOLCANO
MT. COREY
CHESTER MTS.
MUD FLAT MORAINE
SAUNDERS MT.
CREVASSED VALLEY GLACIER
SKUA GULL PEAK
LOW HILLS
MT. STANCLIFF
LICHEN PEAK
CLAUDE SWANSON MTS.
(MANY NUNATAKS)
MT. REA
MT. COOPER
AMES GLACIER
JOHN HAYS INLET
DONALD WOODWARD MT.
HAMMOND GLACIAL OUTLET
HAINES MTS.
GARLAND PEAKS
HERSHEY RIDGE
MT. CLARENCE MACKAY
RANGES
EDSEL FORD
MARIE BYRD LAND
MT. GRACE MCKINLEY
MAWSON SHELF ICE
EDGE OF SHELF ICE
BISCOE BAY
CAPE COLBECK
SCOTT'S NUNATAKS
ARTHUR SULZBERGER BAY
ICE COVERED ISLANDS
ALEXANDRA MTS.
JOHN BOWMAN PEAK
LA GORCE MT.
KING EDWARD VII LAND
ROCKEFELLER MTS.
MT. NILSEN
MT. SEWARD M. PATERSON
MT. HELEN WASHINGTON
ROSS SEA
OKUMA BAY
KAINAN BAY
ROSS SHELF ICE
BAY OF WHALES
LITTLE AMERICA
TRAIL OF THE MARIE BYRD LAND SLEDGING PARTY OCT.-DEC. 1934
160
155
150
145
76
77
78
AUST.
N.Z.
ANT.
S.A.
1. QUEEN MAUD MTS.
2. S. VICTORIA LAND
3. GRAHAM LAND
4. AREA OF MAP

See page 503.

than on the granitic rock, due perhaps to the fact that darker rocks more quickly absorb the sun's heat and produce temperatures for the support of life over a longer period than do lighter-colored ones. The chemical analyses of the rocks are included to enable any reader who may be interested in this somewhat obscure factor in the life of the plant to gauge for himself its importance. Whether or not there is a direct connection between the distribution of the plants and the chemical analysis has not been proved. However, it is apparent that some species show preference either for granitic rock or for metamorphic types, that some are decidedly indifferent to rock composition, and some of either grow best where bird guano is present.

On Mt. Grace McKinley the plant life varied in color decidedly with the type of rock exposures, dikes, etc.; for example, two species of *Umbilicaria (U. rugosa* and *U. cerebriformis)* blended in color almost exactly with a dike of porphyritic diabase, while the coarse-grained granite of the mountain supported seven other species of lichens, including none of the above-mentioned species. Somewhat similar relationships will be noted in the discussion of distribution.

The writer was extremely surprised at the apparent effect of plant life in producing an unusual amount of disintegration of the rock. It led to the following note in his diary: "It would be surprising to know the relative disintegration by plant and by frost action at present. I should not be surprised to learn that they are nearly equal here where plants are almost unthought of."

Close search almost everywhere with a hand lens revealed tiny plants wedged in the inter-crystal cracks. When the crystals were separated by the point of a knife lichen thalli and algae were often discovered on the under-surface. In many places the rocks were so badly weathered that soil material had begun to form. Small pockets of sand and boulder clay in places supported growths of mosses and lichens; at other points the deposits were completely bare. Most generally the plants seemed to respond to localities where they were best protected from the wind and assured of some supply of melted

snow. In plate 33, fig. 2, and pl. 34, fig. 4, plant life is seen growing in small wind-excavated pits on a horizontal granitic surface at Mt. Grace McKinley. Such pockets caught a small quantity of snow which melted to temporary pools of water along whose margins *Alectoria antarctica* was afforded time to grow quite well.

Light.—The light regime through the whole of Antarctica is regulated chiefly by high latitude. The entire continent lies south of the Antarctic circle and the area from which plants were taken in Marie Byrd Land ranges from 76° 30′ to 86° 3′ of south latitude. Therefore a four to five months' period with continuous sunlight exists in summer, a similar period with no direct sunlight in the winter, and the remaining months transitional. While the maximum elevation of the sun is about 36° 30′ in the northern coastal ranges of Marie Byrd Land, it is only a little more than 28° at the apparent limit of southern growth of macroscopic plant life. The elevation of the midnight sun varies respectively in these same localities from less than 10° to 18°.

The extremely low angle of the sun's rays forces them to pass through great thicknesses of atmosphere with consequent elimination of much of their intensity. However, the unusually clear atmosphere of the polar regions, result of the reduction of moisture in the air by low temperatures, and the multiple reflections of the sun's rays across the white snow crystals producing some polarization, tend to compensate for the otherwise ineffective angle of the sun.

That certain light factors are reduced considerably was proved by the reaction of the photographic film used by the entire camp. Most of the film was super-sensitive panchromatic, for which the light-meter calculations indicated fabulously high speeds as compared with regions of lower latitude, but which required much wider apertures and slower speeds to prevent the continuous tendency to under-exposure. Some of the retardation of the film was no doubt caused by lower temperatures. However, the reaction was quite obvious at temperatures slightly below freezing.

The quality of the light through multiple reflection and even from diffusion through heavy clouds was so intense during the summer months that to go without satisfactory sun glasses for more than an hour or so meant a painful attack of snow-blindness. It even affected those wearing inferior glasses.

Two special adaptations which plants apparently made to Antarctic light conditions were unusually dark colors and selective distribution. Most lichens were decidedly black, while others were dark green, gray, brown, or red. Only few types exhibited light colors. In most cases these were of small size, which permitted them to utilize absorbed sun's heat indirectly from moss clumps or from dark rocks upon which they grew. In general their colors were much darker than those of more common lichens of warmer latitudes.

The second reaction, that of distribution, revealed itself in the lack of a specific pattern of orientation, i. e., the plants were not more common on the north side of mountains than on the south. Moreover, lichens were in many places found on the under side of rocks which received only reflected light. One striking example of this was at Mt. Rea-Cooper where a small cave, facing towards the south with a roof sufficiently sloping to allow moisture to run across it by adhesion, supported a luxuriant mass of *Parmelia.* As was true in most cases, this lichen was associated with a super-growth of a species of *Polycaulonia* or *Blastenia* which are red, branching forms, while *Parmelia* is flat and gray, extending usually over wider area than more brightly colored types.

Temperatures.—To study the factors of temperatures affecting the growth of plant life the meteorological records taken by Amundsen in 1911–12, and by Byrd in 1929–30 and again in 1934–35 are available.

The latitude of Little America corresponds approximately with the southern border of northern Marie Byrd Land and the weather regime of the two places may be assumed to be about the same, but tending to minimum rather than to maximum conditions in the latter. The mean yearly temperature as recorded in 1934 was found to be about –12.85° F., while the

mean maximum was but -3.23° F. and the mean minimum was sinking to -22.4° F. In contrast to the warmest temperatures recorded, the minimum was that of just below -72° F. which from the 1929 records and from Amundsen's figures would appear to be about average.

With return of the sun, temperature rises but there is an apparent lag of a month or more before temperatures become much higher. The mean temperature of the summer months, i. e., those months with continuous sunlight, is about 8.75° F. The two months receiving greatest insolation show a mean of 20° F. January is the warmest month with mean of nearly 24° F.

On eighteen days in 1929 and eleven days in 1934 the maximum temperature rose above freezing, while only on January 21 and 22, in 1929, were mean daily temperatures of 32° and 33° F. recorded. Ten unusually warm days continued from January 20 to 29, 1929, during which the maximum daily temperature was: 29°, 37°, 42°, 35°, 35°, 38°, 39°, 30°, 28° and 33° F. However, mean temperatures for these days were correspondingly as follows: 20°, 32°, 33°, 28°, 26°, 27°, 26°, 18°, 15° and 22° F., indicating, no doubt, such maximum heating of the air as occurs in regions with no rock exposures to absorb and to increase the heat by radiation. Very little melting takes place on the surface of the snow. Snowflakes change to crystalline névé and considerable ablation takes place, yet any dark objects lying on the snow usually sink down into it very rapidly, while the whiteness of the snow protects it, by reflection, from melting.

July, August, and September are the coldest months, with a mean of about -37.5° F. Even though each of these months has one or more days when the temperature rises to zero or above (days always accompanied by blizzards of föhn nature from the east), the monthly mean minimum temperature sinks below -48° F.

Diurnal temperature variations are marked but rather erratic. The Antarctic is characterized by its sudden changes in temperature, particularly in winter when it may rise or fall more than 50° within less than twenty-four hours. The coldest

periods are usually accompanied by calms and clear sky, the warmer periods generally by föhn-like blizzards from the east or southwest.

Only a short distance above the surface of the snow during the colder periods the temperature makes a rapid inversion, becoming much warmer by comparison, which might mean that the loftier mountain summits are subjected to warmer air and that their accompanying plant life is exposed to less rigorous minimum temperatures.

It seemed apparent to the observers in the field that as they progressed farther north in their journey through northern Marie Byrd Land the climate became milder. It was somewhat difficult to compare the meteorological records of the party with those at Little America, but they did show several degrees higher temperature on the average. It does not seem unreasonable to assume that in the northern exposures of Marie Byrd Land temperatures may average as much as 10° higher than at Little America, for almost uniform gradation was shown in the temperature records at the Bolling Advanced Weather Station, where Admiral Byrd spent the winter night alone, just south of the 80th parallel with a mean average of about 10° lower than Little America.

The Edsel Ford Ranges were from one to two degrees farther north than Little America, but, more significantly, they extended farther out into the sea, where maritime conditions had a moderating effect. Even though the sea is covered for many miles northward with great floes of heavy pack ice, the open leads of water not only tend to warm the air, but yield much moisture in the form of fog. The fog drifts in from the coast, and as it crystallizes and precipitates it must give off much latent heat which helps to moderate the coastal climate.

The Queen Maud Mountains to the south, however, probably have temperatures averaging from 10° to 30° lower than those to the north.

Additional evidence of milder climate in the mountains lying north of the 77° parallel of latitude was the occurrence of several extensive areas of so-called "blue ice lakes." One of these lay to the west of Lichen Peak and around the base of the

volcano. After returning to camp, melting of discolored ice from this place revived algae, infusoria, rotifers, and water bears. Mt. Helen Washington is also sheathed in glare ice, which cost the 1929 expedition one of its airplanes when the wind lifted it from its glassy moorings. The most striking example of milder climate was discovered on the summit of Skua Gull Peak, a peak so distinctly surrounded by a deep moat that it appeared to be nothing but a small rock until the depth of the trench was realized. The mountain was visited on December 4, before the warmest part of the year, and already very little snow remained on the surface. A low depression on the crest of the mountain served as a catchment basin for melted snow and formed a pond one or two hundred yards long and several inches deep, upon which a light crust of ice had formed (pl. 35, fig. 2). The bottom of the pond was full of ooze and foul-smelling muck, while the sides were encrusted with algae and bird remains. The little pond was nicknamed the "robbers' hang-out," from numerous evidences of skua gulls. Disgorged bones and feathers of the snowy petrel indicated that the scavenger skuas must come here to rest and digest their meals, but no direct evidence of nesting could be discovered, although there was no disputing that the peak had long been sanctuary to a multitude of the large birds. It is no small wonder that with milder climatic conditions, dark rocks absorbing more of the sun's heat, sheltered from wind, and enriched by bird droppings, plant life of this mountain surpassed all others in luxuriance, with possible exception of Mt. Helen Washington of King Edward VII Land, which was itself a rookery of snowy petrel. There again mildness of weather was evidenced by blue ice, although it is questionable whether the position of the mountain is one of great shelter from the winds that are prevalent there. Certainly it is a region of frequent fogs.

The sun's rays upon the rocks have strong heating effect. Black bulb readings have indicated temperatures as high as 120° F. It was often customary for travelers in the region to strip almost naked for comfort while skiing beside the panting dogs. Sunburn was as blistering on the men's faces as freezing had been a few weeks before. There were occasions when the

warm rocks invited a welcome siesta, and within the little orange-covered tents the heating effect of the sun was so great that a man was at times forced to lie on top of his sleeping bag instead of in it, even on occasions when the actual air temperature was well below freezing. A cloud over the sun immediately produced a sensation of chill.

Temperature conditions afford many occasions when plants may thrive for brief growing periods, but the plants must be adapted to unfavorable temperature changes any instant. In general, lichens seem to have many common characteristics which can be associated with their temperature surroundings, i. e., they have for the most part remained so small that they can hardly be noticed with the naked eye; their colors are usually dark to absorb the sun's rays more readily; further, the algal portion has remained buried deep within the structure of the plant. The mosses seem to have overcome most of their handicaps by their caespitose habit. They grew only on mountains which had most favorable conditions and were not found in the Queen Maud Mountains.

Wind.—Wind in the Antarctic promotes the loss of heat, abrasion of plant parts by drifting snow crystals, fracture of plant parts, and distribution of spores and asexual reproduction of the plants.

An area of "low" high pressure is recognized in the vicinity of the South Pole, a snow plateau about 10,000 feet high. As the pressure builds up in the center of the continent the air slides outward in anticyclonic spread. Northward moving air gains velocity as it reaches the coasts of the continent, and rotation of the earth deflects the air to the left, giving strong easterly component. The rush of air is intensified by the descending gradients along the radii of the domed continent, and in places, such as Queen Mary Land, the velocity may be as much as 150 to 200 miles per hour with a yearly mean of 50 to 60 miles per hour. However, on the surface at Little America no velocities of more than about 75 miles per hour were recorded. The outward flowing air is replaced by higher inflowing warm air from the northwest drawn downward to complete the circulation, and consequently even more heated and dried in accord-

ance with true aspect of adiabatically heated föhn winds. An area of constantly low pressure just off the coasts to the north over the warmer sea draws the air outward into the formation of a continuous procession of cyclonic storms moving constantly from the west to east just south of the area of predominant westerlies. Occasionally these cyclonic storms drift inland, carrying fog and snow with them, and often the upper air moving in above the continent brings in considerable quantities of heavy clouds.

Strong winds often drive quantities of sharp-pointed crystals of surface snow before them, little crystals which must often abrade the soft tissues of the plants like a sand blast if snow does not drift about them as protection. The driving wind often breaks loose whole sections of plants and hurls them across the snow, perhaps to other mountain tops where they may find convenient foothold to continue life. The path of outward blowing wind must have a strong bearing upon the distribution pattern of the plants asexually as well as by spores.

When lowest temperatures occur the weather is usually calm, as has been pointed out, and permits organisms to withstand cold that might otherwise be lethal. The warmth of the föhn wind brings a rise in temperature which may prevent excessive loss of heat by making the temperature gradient between the plant and its environment less steep. Men suffer most when air drains from higher slopes. Because of its density it tumbles downward like a cataract without time to warm up. These katabatic winds are usually local but may cause almost instantaneous freezing of the flesh. They are among the most painful factors encountered in polar climatic conditions. Plants of mountain tops may escape the frigid blasts because of their positions upon elevations above the snow fields, and may in places attain enough height to be in the path of the inblowing warmer winds.

Another response possibly due to wind is location of plant life in protected spots where it may be covered by drift snow in times of wind, snow which later serves as a moisture supply when melted by the sun on the heated rocks. Such plants as *Usnea* suggest tiny lignified trees and their branching and

flexibility allow them to withstand strong blasts of air. Most lichens exposed to strongest winds are so firmly attached to the rocks that they can hardly be removed without serious breaking. Spreading types clinging tight to the surface of the rocks are subjected only to ravages of existing snow, while the *Umbilicaria, Parmelia,* and related forms hold their flat thallus close to the surface of the rock, probably as much to profit from the warmth, to remain reduced in size and to conserve moisture, as to keep protected from the wind. The diminutive size of many species gives them small surface area, a primary protection against the wind.

Precipitation, evaporation and available moisture.—The relative humidity of the Antarctic coastal zone is often indicated by measurement to be quite high, but the absolute humidity is, of course, very low because of the inability of the cold air to hold much moisture in suspension. Vapor from the breath lingers for long periods in cold weather, and may be seen to sink slowly if the atmosphere is calm enough. At temperatures of –50° F. or below crystallization of the vapor becomes distinctly audible.

Often fogs of "sea smoke" rolling inland from the ocean hold moisture in such critical suspension that it is deposited as sheets of ice or crystals of hoar frost upon the first objects they meet.

It is almost impossible to measure precipitation exactly. High winds carry such quantities of loose drift along the surface that snow drifts several feet high may form in a few hours with or without any additional precipitation. Dr. Hobbs points out in his theory of glacial anticyclones that much precipitation must occur in the interior of Antarctica and Greenland by fine crystals dropping from cirri in the descending upper atmosphere. The adiabatic outward winds then cause a drying effect so that the edges of the continent may exhibit thinner coverings of snow and ice due to greater drying effect of the warmer, drier air. Some areas just in from the coast in Greenland do show similarity to desert country. However, if such conditions do exist undiscovered in Antarctica the area of the coastal ranges of northern Marie Byrd Land probably ex-

tends out into the marine influence sufficiently to receive more than the average amount of precipitation. Several heavy snow falls were experienced by the exploring party, and fogs as well as crystal deposition were common during the period of exploration.

Ablation and drifting are the chief methods of dispersion of the inland surface névé. It is only where dark rocks project that heating overcomes reflection and permits actual melting of the snow. Even so, the extension of watery areas is very small, for shortly after the water strikes the snow surface it freezes again. It is natural, as has been mentioned before, that plants are found growing most plentifully along avenues of small trickles of water where loose material has accumulated. Some of the little stones lying in the path of the intermittent water had as many as six to ten different species of lichens clinging to them.

Polar conditions are really those of a typical desert, and plant life must be able to adapt itself to them. Many small lichens, some almost microscopic in size, are bud-like in shape and resemble true succulent plants. Their small size requires little water to carry on growth and reproduction. Other large forms have hairy under-surfaces to aid in obtaining water. An adaptation of some types of lichens is to grow on top of moss clumps until the moss is no longer able to live. The dead moss plant, however, still holds much moisture, which remains available as though in a sponge, long after the surrounding rocks have dried up. Even moss plants take advantage of the older growths of dead leaves beneath to protect them and to provide a source of water. The greenest and most hardy-looking clumps of moss are those that have built up adequate supply of "undergrowth."

As has been mentioned, two of the mountain peaks which were most luxuriant in their floral display were host to bird inhabitants. It cannot be certain, however, whether it is the presence of the birds which has encouraged the more luxuriant growth of lichens, mosses, and algae, or whether the same climatic factors which have made these two mountains more desirable as a rookery than the neighboring peaks may not be

the most desirable also for plant growth. While Skua Gull Peak is host to transient McCormick skua gulls, probably because of the presence of a fresh-water pond well sheltered from the wind, the neighboring Lichen Peak, only about seven or eight miles away, is almost as rich in numbers of species even though it bears no evidence of bird life, and the wind has blown small rock fragments over the ice several miles to the west in veritable drifts that were hazards to the sledge runners of the field party. Saunders Mt. also serves as a retreat for McCormick skua gulls.

Mt. Helen Washington, the only collecting point in King Edward VII Land, was the breeding place of snowy petrel. However, from the numbers of birds circling about overhead it was likely that neighboring peaks also served as rookeries for both the snowy petrel and Antarctic petrel. In fact, Lieutenant Prestrud, of Amundsen's Norwegian Expedition,[4] visited Scott's nunataks and reported evidences of a bird rookery there as well as rather extensive presence of plant life.

Snowy petrel were seen flying over Mt. Haines, and during our absence from Mt. Grace McKinley a bird visited an exposed bacteriological plate, which proves that birds do frequent many of the peaks.

DISTRIBUTION OF PLANT LIFE

The detailed description of each species of lichen or moss gives the locality from which it was collected; therefore, the following discussion need deal only with generalities and description of individual peaks. The mountain peaks are grouped as metamorphic sedimentary mountains, or as granitic mountains, following the route of the trail journey from west to east.

Metamorphic Sediments and Associated Dike Rocks

Garland Hershey Ridge: 77° 38′ S.–147° 15′ W.—Three small exposures were visited in the ridge of nunataks lying between Mt. Grace McKinley and Haines Mts. The exposures are all

[4] Amundsen, R. E. G. The south pole: an account of the Norwegian Antarctic Expedition in the Fram, 1910–1912. Tr. A. G. Chater, London. J. Murray, 1912. [See **2**: 395.]

low and apparently have only lately melted out of the ice-covering of snow. Only two species were found, both growing on orthoclase-sericite schist and dark gray slate.

Buellia grisea and *Lecidea Byrdii.*

Haines Mountains: 77° 30′ S.–146° 45′ W. (Pl. 33, fig. 4).—Much more extensive than Garland Hershey Ridge are Haines Mountains, but only the most northerly exposures, which probably yielded best growth conditions for plant life, were visited. Most of the mountain was composed of sericite schist which weathered with evidence of much iron. Exposures of orthoclase-sericite-siderite schist were characterized by square pits of dissolved minerals and extensive iron stains.

This was one of the regions of less dense growth and no mosses were found. *Alectoria antarctica, Buellia alboradians, B. floccosa, B. grisea, B. muscicola, B. pallida, B. stellata,* and *Usnea antarctica.*

Mt. Donald Woodward: 77° 18′ S.–145° 50′ W. (Pl. 36, fig. 5; pl. 37, fig. 4).—Of several scattered exposures lying between John Hays Hammond Inlet (outlet glacier) and Ames Glacier, Mt. Donald Woodward is the northernmost and largest. Better climatic conditions were revealed here by the first appearance of tiny clumps of moss and more numerous species of lichens, but the mountain had a sparse flora in comparison with the more northern peaks of the land. Much plant life grew over clumps of moss or on loose sandy loam, derived from the predominant rock type which was biotite-sericite schist.

Growing loose, easily detached, on clumps of moss or sandy loam: common—*Lecidea Siplei* and *Gasparrinia Siplei* (the only species found both on rocks and loose); occasional—*Catillaria floccosa, Lecanora griseomarginata, Parmelia leucoblephara, Pyrenodesmia Darbishirei, Usnea frigida. Grimmia Antarctici* and its var. *pilifera* were the only mosses found.

Growing on biotite-sericite schist: common—*Buellia flavoplana* (only on this mountain but described from S. Victoria Land), *B. grisea, B. stellata, Gasparrinia Siplei, Lecidea capsulata, Rhizocarpon flavum,* and *Thelidium inaequale;* occasional—*Alectoria antarctica, Buellia dendritica, Kuttlingeria rufa* (endemic), *K. rutilans, Parmelia leucoblephara, Polycauliona pulvinata, Protoblastenia alba* (endemic), and *Thelidium Caloplacae.*

Lichen Peak: 76° 55′ S.–145° 20′ W.—One of the numerous mountains of the Claude Swanson group, located just northeast of Mt. Rea-Cooper is Lichen Peak. Although subjected

to much wind, in places it exhibited luxuriant growths of plant life—mosses, lichens, and small, dark, irregular masses of algae resembling *Nostoc*. The mountain rises smoothly above the snow surface without the usual wind moat at the contact line. The surface of the mountain was broken into fine talus on the lee side, and rock chips were strewn for miles in drifts piled westward over the ice. The mountain is composed mainly of sericite-orthoclase schist, gray slate, and arkosic sandstone. Because the two latter types are more friable, fragments are easily plucked out by wind, and plant life is less abundant on them.

Growing on gray slate: *Lecanora lilacina*, *Lecidea Siplei*, and *Parmelia variolosa*.

Growing on arkosic sandstone: very common—*Usnea frigida;* common—*Lecidea capsulata;* occasional—*Blastenia grisea* (endemic) and *Lecidea Coreyi*.

Growing on sericite-orthoclase schist: very common—*Alectoria antarctica*, *Buellia frigida*, and *Candelariella albovirens;* common—*Lecidea capsulata*, *L. Coreyi*, *L. Stancliffi*, *Parmelia leucoblephara*, and *Usnea frigida;* occasional—*Buellia albida*, *B. alboradians*, *B. grisea*, *B. muscicola*, *B. stellata*, *Huea flava*, *Pannoparmelia delicata*, *P. pellucida* (endemic), *Protoblastenia alba*, *Rhizocarpon flavum*, *Sarcogyne grisea*, *Thelidium inaequale*, and *Umbilicaria spongiosa*.

Growing loose, easily detached, on moss clumps or on loose sandy loam: very common—*Alectoria antarctica*, *Catillaria floccosa*, *Lecidea Siplei*, *Protoblastenia flava*, and *Pyrenodesmia Darbishirei;* common—*Parmelia variolosa* and *P. Coreyi;* occasional—*Blastenia succinea*, *Buellia Siplei*, *Candelariella chrysea*, *Lecanora griseomarginata*, *L. lilacina*, *L. lilacinofusca*, and *Umbilicaria spongiosa*. The mosses were *Barbula Byrdii* and *Sarconeurum glaciale*.

Skua Gull Peak: 76° 50′ S.–145° 30′ W. (Pl. 35, figs. 2, 4; pl. 36, fig. 2).—This mountain mass, referred to several times in the preceding text because of the comparative luxuriance of its plant life (mosses, lichens, and algae), its odd formation surrounded by a deep depression, and the pond located upon its summit which is host to transient skua gulls, lies just two or three miles east of Saunders Mt. but is geologically of an altogether different origin. Mt. Stancliff is a larger and eastern exposure of the same mountain mass, and together they form a northern outlier of the Claude Swanson Mountains separated five or ten miles from the central mass of those peaks. While Mt. Stancliff appears to be sericite schist and fine-grained dike rock, there is more abundance of dark greenish gray slate on Skua Gull Peak, and also more of the

pitted orthoclase-sericite-siderite schist similar to that on the northern end of Haines Mts.

Growing on dark greenish gray slate: very common—*Gasparrinia Siplei, Lecanora griseomarginata, L. Siplei, Protoblastenia flava, Pyrenodesmia Darbishirei, Parmelia variolosa,* and *Umbilicaria cerebriformis;* common—*Blastenia succinea, Buellia dendritica, B. olivaceobrunnea, Catillaria cremea, C. floccosa, Parmelia griseola, Protoblastenia aurea, Thelidium Caloplacae,* and *T. parvum;* occasional—*Candelariella albovirens.*

Growing on orthoclase-sericite-siderite schist: very common—*Gasparrinia Siplei, Lecanora Siplei, Protoblastenia flava,* and *Usnea frigida;* common—*Buellia albida, B. olivaceobrunnea,* and *Thelidium Caloplacae;* occasional—*Buellia muscicola, Lecidea Siplei, Polycauliona pulvinata, P. sparsa, Rinodina sordida* (endemic), and *Umbilicaria rugosa.*

Growing on fine-grained dike rock: very common—*Alectoria antarctica, Gasparrinia Siplei, Lecanora Siplei, Polycauliona pulvinata, Pyrenodesmia Darbishirei, Umbilicaria cerebriformis, U. rugosa,* and *Usnea frigida;* common—*Protoblastenia aurea, Umbilicaria pateriformis,* and *Usnea antarctica;* occasional—*Biatorella arachnoidea, Buellia albida,* and *Lecanora carbonacea* (endemic).

Growing loose, easily detached, on clumps of moss, or on sandy loam: very common—*Gasparrinia Siplei, Lecanora griseomarginata, Parmelia Coreyi, Protoblastenia flava, Pyrenodesmia Darbishirei,* and *Usnea frigida;* common—*Alectoria antarctica* and *Blastenia succinea;* occasional—*Kuttlingeria rutilans, Lecidea Siplei, Polycauliona sparsa, Umbilicaria spongiosa,* and *Usnea antarctica.* The following mosses were collected: *Bryum antarcticum, B. Siplei, Barbula Byrdii, Grimmia Antarctici,* and *Sarconeurum glaciale.*

Mt. Stancliff: 76° 51′ S.–145° 20′ W. (Pl. 35, fig. 1).—Closely associated with Skua Gull Peak, a smaller twin nunatak lying immediately to the west, is Mt. Stancliff. It helps to shelter Skua Gull Peak from wind and is consequently not so rich in plant growth, but far surpasses Haines and Woodward Mountains. The mountain appears as a low nunatak from the west, but on the east it exposes a much bolder face as the ice drops away from it into the wide crevassed glacier valley. The beds of the mountain were less contorted and mostly composed of sericite schist and fine-grained dike rock. The plant collection was taken from the eastern end of the exposure. Mosses were present but not very plentiful.

Growing on sericite schist: common—*Lecidea capsulata* and *Rhizocarpon flavum;* occasional—*Buellia albida, B. floccosa, B. olivaceobrunnea,* and *Gasparrinia Siplei.*

Growing on fine-grained dike rock: common—*Rhizocarpon flavum;* occasional—*Polycauliona pulvinata* and *Huea flava.*

Growing on a single piece or erratic pink granite: occasional—*Alectoria antarctica* and *Sarcogyne grisea.*

Growing loose, easily detached, on clumps of moss or on sandy loam: occasional—*Lecidea Siplei* and *Protoblastenia flava*. Probably some species of *Usnea* occurred on this mountain but failed to be collected.

GRANITIC MOUNTAINS

Mt. Helen Washington: 78°05′ S.–155°20′ W. (Pl. 32, figs. 2, 3; pl. 33, fig. 5).—The mountain contacted last by the field party upon its return journey had previously been visited by Dr. L. M. Gould and party, as well as by Admiral Byrd who came to Gould's rescue when his plane blew away in a strong blizzard on the 1929 expedition. Time permitted for studying the region was cut short by the reduced food supply and by orders for the party to return to Little America. It was the only exposure visited in King Edward VII Land. A rookery of snowy petrel on the summit and frequent fogs and consequent milder climate furnish conditions for an extensive cover of mosses and lichens on every suitable location. Very recent subsidence of the ice is apparent from a distinct band above which *Usnea* is so dominant as to give the mountain of pink granite a blackish green tint, noticeable even from the airplane. However, below the line, which resembles a coastal high-water line, stretches a band of bare rock from 20 to 100 feet or more wide, comparatively free of *Usnea* or other growths. At the present contact between the snow cover and the bare rocks of the nunatak is a zone of melting, which when prodded by the point of a ski pole yielded fragments of bright green algae. Algae were in many places found matted on rocks and in tiny pools of water, which under the microscope revealed other small organisms. On the summit mosses and lichen forms usually associated with them were enriched by bird droppings, but *Usnea* and *Umbilicaria* grew luxuriantly, mainly because of milder climatic conditions. As stated before, the area surrounding the mountain is sheathed in glare ice. This is pitted by great accumulations of rock fragments which have melted into the surface but still show through. The mountain is composed mostly of coarse-grained pink granite with a few large crystalline quartz veins, and inclusions of highly weathered greenish granite in which orthoclase is dominant. Although

there was some variation in the distribution of plant life on different rock types, the differences are slight and may be due to irregularities in collecting. The mountain top was so plentifully covered that only a comparatively few of the specimens could be taken and identification in the field was impossible.

Growing on coarse-grained pink granite, coarse-grained pinkish leucogranite, white quartz crystals and quartzite, and weathered coarse-grained green granite: very common—*Alectoria antarctica, Candelariella albovirens, Protoblastenia flava, Umbilicaria cerebriformis, U. rugosa, U. cristata, U. pateriformis,* and *Usnea antarctica;* occasional—*Buellia dendritica, B. muscicola, B. olivaceobrunnea, B. Russellii, Catillaria granulosa* (endemic), and *Lecidea cancriformis.*

Growing loose, easily detached, on clumps of moss, or on chips of rock or sandy loam: very common—*Alectoria antarctica, Protoblastenia flava, Rinodina olivaceobrunnea, Umbilicaria rugosa, Usnea antarctica,* and *U. frigida;* common—*Buellia muscicola, Protoblastenia aurea,* and *Umbilicaria cerebriformis;* occasional—*Catillaria floccosa, Polycauliona pulvinata,* and a sterile yellow species found also on Mt. Grace McKinley. The mosses were *Bryum Siplei* and *Grimmia Antarctici* and its var. *percompacta.*

Eggshells, bones, and some rock surfaces were covered with dry patches of algae and abundant mosses.

Mt. Grace McKinley: 77° 55′ S.–148° 15′ W. (Pl. 33, fig. 2; pl. 34, figs. 2–4).—Mt. Grace McKinley, the most westerly exposure of Edsel Ford Ranges, was the first mountain visited, and a month later it was revisited on the return journey. Continental ice pushes up from the south and almost over the mountain, while the north side drops steeply with a cirque-cut face several hundred feet high. The mountain was not rich in its flora, principally because most of the rock exposed was vertical and inaccessible, and secondly, the slight evidence of melting around the exposures suggested that the temperatures were less favorable for plant growth than other mountains farther north in Edsel Ford Ranges. The western exposure appeared as a mere "peeping-through" of rocks, but actually the ridge was 20–50 feet wide and more than 100 yards long. Three types of rock appeared in the exposure—fine gray granite, pegmatite granite, and a highly weathered dike of porphyritic diabase; the latter displayed a distinct type of species which blended almost imperceptibly with the greenish color and texture of the rock. The main mass of the mountain is composed of coarse-grained pink leucogranite.

Growing on leucogranite (coarse pink granite): common—*Alectoria antarctica, Lecidea Coreyi, Protoblastenia aurea, Usnea frigida;* occasional—a sterile yellow species found also at Mt. Helen Washington.

Growing on leuco-sodaclase granodiorite (fine-grained granite) and crypto-crystalline pinkish granite near dike contact on west end of mountain: common—*Lecidea Coreyi* and *Usnea antarctica;* occasional—*Lecidea Stancliffi, Umbilicaria cerebriformis,* and a sterile yellow species found also at Mt. Helen Washington.

Growing on weathered dike of porphyritic diabase. Plants often growing loose or easily detached on small chips of rock. No other fine loose material occurred on the mountain except an apparently sterile pegmatite vein of quartz, beryl, and biotite. Common—*Umbilicaria cerebriformis* and *U. rugosa.*

Mt. Rea-Cooper: 77° 07′ S.–145° 30′ W. (Pl. 33, fig. 3; pl. 34, figs. 1, 5; pl. 35, fig. 3; pl. 36, figs. 1, 3; pl. 37, fig. 3).—Because it represents twin masses of the same mountain structure, divided by a narrow glacier-carved gap, this mountain is referred to by a double name. The mass was first sighted on the exploratory flight of December 5, 1929, and named Mt. Rea, which name now is applied to the northern exposure, while the southern is named Mt. Cooper. Actually the field party contacted Mt. Cooper for most of its observations, but knew both exposures as Mt. Rea. In early literature and geological publications description of both peaks was included under the name Mt. Rea, but here it seems wise to use both names. The mountains are composed of coarse-grained leucogranite which stands out in bold ice-carved relief with sheer cliffs rising 1000 feet or more. Conspicuous inclusions of stoped metamorphic rocks are often exhibited along the crest of the mountains, as are occasional dikes of granodiorite, etc. Most of the plant collection was made along the lower exposures, moraines, and talus slopes where access to the mountain was easiest. Many plants grew on stones in crevices where water trickled on warm days. Mosses were common but not so abundant as at Chester Mts., Mt. Helen Washington, Lichen Peak, or Skua Gull Peak.

Growing on coarse-grained leucogranite (light pink), also on coarse-grained granodiorite: very common—*Buellia brunnescens,*[5] *B. chrysea, B. dendritica,*[5] *Lecidea ecorticata,*[5] and *Rinodina sordida;* common—*Alectoria antarctica, Catillaria arachnoidea,*[5] *C. floccosa,* and *Usnea frigida;* occasional—*Buellia stellata, Catillaria*

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[5] These species were found on no other mountain, but were relatively abundant on this mountain, which might suggest that such species may have a wider distribution than at present known.

inconspicua, Lecanora lilacina, L. subolivacea (endemic), *Lecidea capsulata,* and *L. Stancliffi.*

Growing loose, easily detached or on sandy loam formed from leucogranite: common—*Catillaria floccosa, Polycauliona pulvinata,* and *Protoblastenia flava;* occasional—*Blastenia succinea, Buellia (Diplotomma) Siplei, Huea flava, Lecidea Wadei, Parmelia variolosa, Rinodina olivaceobrunnea,* and *Thelidium parvum. Grimmia Antarctici* and its var. *pilifera* were the only mosses collected.

Saunders Mt.: 76°52′ S.–145°45′ W.—Saunders Mt., just north of the Rea-Cooper group, and the largest exposure of Edsel Ford Ranges, is composed mostly of coarse-grained gray granodiorite. The southern end, visited by the writer, was strikingly devoid of plant life. The western side, visited by Wade and Stancliff, yielded plant species typical of the larger conspicuous forms found at Mt. Rea-Cooper, including moss, *Usnea, Alectoria, Parmelia,* etc. This incomplete collection was carefully placed in a sterilized vial for bacteriological samples and was used for that portion of the biological survey. It is unlikely that there were any new or unusual species in the small collection. Disgorged bones and feathers gave evidence that skua gulls use the northern end of Saunders Mt. as a retreat, as they do at the neighboring Skua Gull Peak.

Chester Mts. (southeast peak): 76°40′ S.–145°20′ W. (Pl. 37, fig. 5).—One of the most northerly nunataks of floral importance visited by the field party was the southeast peak of Chester Mts. Although small, the exposure was the only one approachable from the south. Mosses appeared unusually green and fresh, and cushions were often several inches in diameter. Structure of the mountain, coarse-grained gray granodiorite with occasional quartzitic veins and other inclusions, was similar to that of Raymond Fosdick Mts. which neighbor it. Although the mountain was about thirty miles farther north than Mt. Rea-Cooper it had fewer plant forms, a condition possibly due to a south-facing stope in direct sweep of prevailing easterly blizzards.

Growing on coarse-grained granodiorite: common—*Candelariella chrysea* and *Catillaria floccosa;* occasional—*Alectoria antarctica, Buellia dendritica, B. frigida, Catillaria inconspicua,* and *Protoblastenia flava.*

Growing on quartzitic vein material: occasional—*Buellia stellata, Candelariella albovirens, Lecidea capsulata,* and *Sarcogyne angulosa.*

Growing loose, easily detached, on moss clumps or on sandy loam: common—*Candelariella chrysea* and *Catillaria floccosa;* occasional—*Parmelia leucoblephara.*

Mt. Corey: 77° 25′ S.–144° 35′ W. (Pl. 37, fig. 1).—Lying just south of the volcano of Raymond Fosdick Mts., Mt. Corey is a small exposure closely related to two neighboring exposures of coarse-grained pinkish leucogranite. It stands conspicuous on the northern brink of the depression leading down into a wide-crevassed glacial valley, which served as an effective barrier to wider exploration in the region, and was the scene of three accidents which nearly brought disaster to the field party. Because of its isolated position, some of the plant specimens were collected under sterile conditions for bacteriological investigation. In general, vegetation was very sparse as compared with other mountains just to the south, perhaps because of its recent emergence from the retreating ice cover.

Growing on coarse-grained leucogranite: common—*Usnea antarctica* and *U. frigida;* occasional—*Alectoria antarctica* and *Candelariella albovirens.* The mosses were *Grimmia Antarctici* and *Sarconeurum glaciale.*

Mt. Raymond Fosdick and the Volcano: 76° 34′ S.–144° 15′ W.—These peaks are included in the discussion principally because they were the most northerly mountains visited and were more nearly devoid of plant life than any other exposure. Climatic conditions could hardly account for sparseness of vegetation, for one of the most pronounced "blue ice lakes" borders the base of the volcano, which indicates melting temperatures. A medial moraine extends southward a mile from the volcano and is composed of basic lava with conspicuous inclusions of bright green olivine. The lava weathers easily and the moraine contains much fine, dusty material.

Rising above the volcano to the north is the main backbone of the Raymond Fosdick Mountains. It is composed of contorted gneisses formed when the volcano erupted on its southern side. The exposure was visited toward the close of a three-day blizzard which made searching for plant specimens difficult. Whether the peak was devoid of plant life one cannot be absolutely certain, but apparently it had no more vegetation than the volcano and moraine which were searched diligently under more favorable conditions.

In contrast to the lack of lichens and mosses was the abundance of microscopic life in a small pond of ice formed in the moraine at the foot of the mountain. The pink color of the ice attracted attention, and small samples were taken and later melted at Little America. Under the microscope red rotifers, water bears, infusoria, and algae began a vigorous rejuvenation of life. The original source of these organisms can only be guessed at.

The nearest bird life observed in this vicinity was at Skua Gull Peak and at Saunders Mt. nearly 40 miles "down wind," i. e., away from prevailing wind.

Several assumptions may explain lack of vegetation in the volcano vicinity: that mountain and moraine may have been too recently uncovered to have received a plant cover; that prevailing easterly winds would tend to bring less spores to the mountain because there are few nunataks to the east; that the black porous lava becomes quickly heated by the sun and evaporation follows too rapidly to support vegetation—in fact, the moraine was dusty dry; that some chemical in volcanic material may be unsuitable for plant growth; that the position of the range on the south side might permit less light, a condition similar to the south side of Saunders Mt., but in opposition to the luxuriant growth of Mt. Helen Washington; and lastly that air drainage may have been a factor, for heavy winds pour down the mountain, as evinced by orientation of snow drifts.

Queen Maud Mts.—The plant specimens obtained by the Queen Maud Geological Party were collected at two stations, incidental to geological investigation,[6] and there are few notes on distribution. The forms are unusually interesting because they are the most southerly plants thus far recorded in the world, and three, as mentioned before, were found within 237 nautical miles of the geographical South Pole. This is considerably farther poleward than land plants grow in the Arctic, due to lack of islands or nunataks in the Arctic Sea. The plants were growing in small crevices on granites and

[6] Blackburn, Quin A. The Thorne glacier section of the Queen Maud Mountains. Geog. Rev. **27**: 598–614. *25 fig.* 1937.

schists, and were generally tiny forms rather easily detached. They grew also on chips of rock and sand. No mosses were found.

Three of the lichens are also found in the mountains of Marie Byrd Land and King Edward VII Land, two of them sterile. The rest are endemic. A species of *Hormiscium* parasitizes some thalli and appears the same as that to the north.

Durham Point (Durham Mt., N.E. portal of Thorne Glacier): approximately 85° 31′ S.–151° 20′ W.; elevation 1200 ft.—

Growing on fine-grained granite (deep olive buff), granitic sandy loam, dark brownish gray schist, and other schists: common—*Lecidea cancriformis* (also in King Edward VII Land) and *Protoblastenia citrinigricans;* occasional—*Alectoria antarctica, Buellia Russellii, B.* sp. (sterile), *Lecidea Blackburni, Lecanora fuscobrunnea,* and *Hormiscium* sp.

Scudder Mt.: 86° 03′ S.–150° 40′ W., between Organ Pipe Mts., Mt. Bruce Harkness and Mt. McKercher: (Pl. 36, fig. 4; pl. 37, fig. 2.—

Growing on granitic sandy loam, easily detached: common—*Lecidea Blackburnii, L. cancriformis, Protoblastenia citrinigricans;* occasional—*Lecidea Painei.*

From the factors governing growth of plants and their distribution upon different nunataks, a few generalities and observations suggest themselves. They are enumerated to aid readers who are interested in studying more closely the pattern of distribution of such plant species as are pioneers upon a glaciated land simultaneously with the retreat of the ice. It is difficult to explain what factors have made so many species endemic to this polar land without known affinities in warmer latitudes; but perhaps in warmer climates other plant forms crowd out polar flora, or the polar species may not be properly adaptable to conditions in warmer latitudes, customarily considered more ideal for plant growth. On the other hand, polar conditions may have forced the plants arriving from the outside world to adopt new forms with altered specific characteristics in order to exist under such rigorous and dry conditions. The following pages are a summary of the species and their general distribution characteristics.

Distribution and substrates	Plants	Number mts. where found	Remarks
Mosses extending into both Graham Land to the east and South Victoria Land to the west	*Sarconeurum glaciale* *Bryum antarcticum*	3 1	
Lichens extending only into South Victoria Land to the west, which lies in the path of prevailing easterly winds blowing from Marie Byrd Land	*Usnea antarctica* *Protoblastenia aurea?* *Buellia frigida* *Buellia flavoplana*	5 2 2 1	*Protoblastenia aurea* is doubtfully included here, as the material from South Victoria Land is sterile
Moss extending only into Graham Land to the east, from which prevailing easterly winds blow to Marie Byrd Land	*Grimmia Antarctici*	6	
Lichens widely distributed on both dark metamorphic sediments and on granitic mountains	*Alectoria antarctica*	11	Widest distribution of any species, from Queen Maud Mts. to almost all coastal mountains
	Usnea frigida	7	Most conspicuous species and probably most abundant; very hardy but sterile
	Candelariella albovirens	7	Wide distribution but not very numerous
	Catillaria floccosa *Protoblastenia flava*	6	Usually growing loose or easily detached where mosses were found
	Usnea antarctica	4	Much less abundant than *Usnea frigida*
	Buellia sp. (sterile)	4	Wide distribution including Queen Maud Mts., King Edward VII Land, and Marie Byrd Land, but not abundant
Lichens widely distributed between granitic and dark metamorphic sedimentary mountains	*Buellia muscicola* *Buellia dendritica*	4	Not abundant, distribution similar for both species.
	Polycauliona pulvinata	4	Not abundant and usually associated with *Parmelia* sp., upon which it seemed to be growing
	Umbilicaria rugosa	3	Abundant where found, seeming to require dark weathered rocks

Distribution and substrates	Plants	Number mts. where found	Remarks
Lichens widely distributed on both granitic rocks and dark metamorphic sedimentary rocks, apparently preferring the former	*Usnea antarctica*	5	Widely distributed on igneous mts. and on dark sedimentary mts. restricted to Skua Gull Peak
	Umbilicaria cerebriformis	3	Grows under conditions similar to *U. rugosa*
Lichens widely distributed on both granitic and dark metamorphic sedimentary rocks, apparently preferring the latter. On only one granite mountain	*Buellia stellata*	5	Only on an igneous erratic at Mt. Stancliff
	Buellia grisea *Lecidea capsulata*	5 4	Commonly on sericite schist
Lichens on peaks of different material 40–50 miles apart; none abundant	*Lecidea Coreyi* *Lecidea Stancliffi*	2	On Mt. Grace McKinley and Lichen Peak
	Lecidea Wadei	2	On Mt. Rea-Cooper and Garland Hershey Ridge
Moss and lichens growing on different rock structure but localized on neighboring moun tains	*Catillaria floccosa* *Parmelia variolosa* *Blastenia succinea*	3	On Mt. Rea-Cooper, Lichen Peak, and Skua Gull Peak
	Candelariella chrysea	2	Loose or easily detached on Chester Mts. and Lichen Peak
	Buellia frigida *Parmelia leucoblephara*	2 3	Same peaks as above but on rocks, the last species also on Mt. Donald Woodward
	Grimmia Antarctici var. *pilifera*	2	On Mt. Rea-Cooper and Mt. Donald Woodward
	Buellia Siplei	2	Loose or easily detached on Mt. Rea-Cooper and Lichen Peak
	Buellia chrysea	2	On rocks, Mt. Rea-Cooper and Lichen Peak
	Buellia pallida	2	On rocks, Mt. Rea-Cooper and Haines Mts.
Moss and lichens growing on or near mountains wher bird life is present; correlation uncertain	*Buellia olivaceobrunnea* *Umbilicaria pateriformis* *Protoblastenia aurea* *Bryum Siplei*	3 2 2 2	On Mt. Helen Washington and Skua Gull Peak; first species also on Mt. Stancliff

Distribution and substrates	Plants	Number mts. where found	Remarks
Lichens growing only on igneous rocks	*Lecidea cancriformis*	2	Wide distribution, on Mt. Helen Washington and Queen Maud Mts.
	Rinodina olivaceobrunnea	2	On moss clumps or sandy loose material at Mt. Rea-Cooper and Mt. Helen Washington
	Catillaria inconspicua	2	On rocks in restricted locality on Mt. Rea-Cooper and Chester Mts.
Moss and lichens only on dark metamorphic sedimentary mountains (schists and slates); widely distributed	*Lecidea Siplei* *Pyrenodesmia Darbishirei* (sterile)	4	Both species growing loose or easily detached on mountains where mosses are common
	Lecanora griseomarginata *Barbula Byrdii*	3	Wide distribution, growing loose or easily detached
	Gasparrinia Siplei *Rhizocarpon flavum*	3	Restricted distribution but abundant; commonly on rock
Lichens widely distributed on two dark sedimentary mountains	*Thelidium Caloplacae* *Kuttlingeria rutilans*	2	On Mt. Donald Woodward and Skua Gull Peak
	Thelidium inaequale	2	On sericite schist, Mt. Donald Woodward and Lichen Peak
	Buellia alboradians	2	On sericite schist, Lichen Peak, and Haines Mts.
	Buellia floccosa	2	On sericite schist, Haines Mts., and Mt. Stancliff
Lichens with limited distribution on two or more dark metamorphic sedimentary mountains	*Buellia albida*	3	On sericite schist, Mt. Stancliff, Lichen Peak, and Skua Gull Peak
	Catillaria cremea *Parmelia Coreyi* *Umbilicaria spongiosa*	2	On Lichen and Skua Gull Peaks. The second is more abundant, the last is the largest species
	Huea flava	2	On rocks, Lichen Peak and Mt. Stancliff
	Sarcogyne grisea	2	On rocks, Lichen Peak and Mt. Stancliff, at latter on erratic igneous rock
Lichens growing on igneous schists and endemic to Queen Maud Mts.	*Lecidea Blackburni* *Lecidea Painei* *Protoblastenia citrinigricans* *Lecanora fuscobrunnea* *Buellia Russellii*	1	Growing nearest the South Pole, collected by the Queen Maud Geological Party

Distribution and substrates	Plants	Number mts. where found	Remarks
Moss and lichens growing only on a single igneous mountain	*Buellia brunnescens* *Buellia dendritica* *Lecidea ecorticata* *Lecidea Byrdii* *Catillaria arachnoidea* *Lecanora subolivacea*	1	Growing on coarse-grained leucogranite, Mt. Rea-Cooper; usually on small rocks in small trickles of water. First three species very common
	Grimmia Antarctici var. *percompacta* *Catillaria granulosa* *Umbilicaria cristata*	1	On coarse-grained leucogranite, Mt. Helen Washington
	Sarcogyne angulosa	1	On quartzite, Chester Mts.
Lichens growing sparsely on a single mountain of dark metamorphic sedimentary rocks	*Biatorella arachnoidea* *Lecanora carbonacea*	1	On dike rocks at Skua Gull Peak
	Rinodina sordida *Polycauliona sparsa*	1	On sericite schist, Skua Gull Peak
	Umbilicaria spongiosa *Parmelia griseola*	1	On rocks at Skua Gull Peak, but easily detached
	Blastenia grisea *Pannoparmelia pellucida* *Pannoparmelia delicata*	1	On sericite schist, Lichen Peak
	Lecanora lilacinofusca *Lecanora lilacina*	1	Loose or easily detached, Lichen Peak; mosses common
	Kuttlingeria rufa *Buellia flavoplana* *Protoblastenia alba*	1	On sericite schist, Mt. Donald Woodward

SUMMARY

From thousands of plant colonies reviewed in the field and hundreds brought back to the laboratory for identification, at least 89 species of lichens and 5 of mosses are determined. The lichens were collected from some 215 distinct localities on 12 mountains, and represent not only a random cross-section through Marie Byrd Land and King Edward VII Land, but rather diverse conditions as well. On 8 of the 12 mountains there were relatively few mosses. Where they were most abundant, lichen forms were also most numerous.

Of the two dominant rock types in the region, dark metamorphic sedimentary rocks and the loftier igneous rocks, based

on observations made in northwestern Marie Byrd Land, two-thirds of the plant species were found on the former type, probably because snow melts faster on dark rocks than on light-colored granitic rocks. Mt. Stancliff, with its accompanying Skua Gull Peak, surrounded by larger mountains on all sides, lies within the central zone of mountain exposures and represents a focus of abundance in plant growth. The warming effect of lower latitude is obvious, but more important are the factors of available moisture and shelter from wind.

Mt. Helen Washington, with its snowy petrel rookery (pl. 33, fig. 5), exhibits remarkable abundance of plants, but the number of species is little more than half that of Skua Gull Peak where birds are fewer. Even Mt. Rea-Cooper and Lichen Peak, devoid of bird life, have more species than Mt. Helen Washington, a response perhaps to shelter from wind or to a warmer latitude of one degree farther north. While Mt. Helen Washington lies to the south of the elevated mass of King Edward VII Land, the former is more exposed to the north.

The fact that all species of mosses and lichens in the collection are endemic to the Antarctic, if not to the locality, brings the question of origin strongly to the foreground. Several different conclusions might be suggested, but the writer feels that no definite proof is possible in the light of meager data from other sections of Antarctica and adjacent land masses.

First, it might be conjectured that plant spores have existed in crevices of rock, imprisoned in ice or suspended in upper atmosphere, and represent an ancient flora of Antarctica before the ice age, which has once more found a foothold on the denuded peaks. However, lack of endemic genera casts immediate doubt upon such a conclusion.

If then, as an alternative, it is concluded that plant spores have been transported to the continent from land masses to the north, distribution within the continent demands explanation. If spores are so widely distributed within Antarctica, why should not some of the forms escape or more common forms enter? Answers to this question lie in the fact that perhaps still too little is known about alpine lichens of the Andes, Australia, New Zealand, and of the intermediate islands. It is

possible that common species entering the Antarctic must make such rapid adjustments to new conditions that the speed of evolutionary processes to form new species is hastened as plants adapt themselves to the rigor and dryness of the new climate.

Wind has probably been the most instrumental means of distributing plant spores, and to a lesser extent redistributing locally broken vegetative parts from peak to peak. Ice and water have had an active but more limited part in the processes. Detailed study may possibly prove to what extent birds help in disseminating spores. It must be kept in mind that snowy petrel, McCormick skua gull, and Antarctic petrel are natives of Antarctica and have a range that in general does not extend much beyond the northern limit of the pack ice, although occasionally the birds pass the 50th parallel. If they have aided in distributing spores and plant parts, it may have been through island bridges, or, as is more likely, they have been of greater aid in redistributing plant life after it entered the continent than in actually helping to introduce it.

The writer concludes that the most important part played by birds is enrichment of rock exposures with guano. It is apparent that two of the mountains exhibiting the greatest wealth in quantity of plants were those which had visiting bird life. On the other hand, many surrounding mountains, almost as luxuriant in growth, have species not represented on mountains visited by birds. Climatic and shelter conditions which made mountains desirable for birds were also conditions conducive to optimum plant growth within the region. If the bird-frequented mountains, i. e., Skua Gull Peak and Mt. Helen Washington, had representatives of all of the species found elsewhere, the argument for bird distribution of spores would be very strong, but such was not the case. In further support of bird activities, it should be recalled that every inland party going toward Queen Maud Mts. has reported the appearance of occasional skua gulls, which may take solitary flights directly across the continent. However, only three of the Queen Maud species found by the Byrd expedition had affinities with coastal species.

The collection made by the Marie Byrd Land party represents, no doubt, the majority of the larger and more conspicuous species, but as may be seen from the data, most of the mountains had species apparently restricted to them. Of mountain exposures where plant life probably exists, less than 10 per cent of the area has been visited. No doubt more than twice as many species prevail as have been found; and if the regions could be charted much more information concerning the distribution factors of the plants lying on the poleward margin of plant growth would be available.

There is need for more collecting. Even in the regions which have been visited most frequently, it is likely that only a few of the lichen species have been brought back for identification. Most observers not especially interested in plant life would overlook all but the most obvious plants, for the majority of the lichens appear as little more than crumbs of dirt on rocks. Keen search for plant growth will be necessary in the future for more complete collections from the continent. Specimens from the coasts bordering the Indian Ocean and from the mountains discovered recently by Lincoln Ellsworth east of Marie Byrd Land will be especially valuable.

The British Graham Land Expedition led by Rymill, which returned in 1937, has made a collection of plants which, when identified, will throw more light upon plants to the west of Graham Land.

In the light of observations made within Marie Byrd Land it seems probable that the plant species of Antarctica are much more numerous on the continent proper than the one or two hundred known species thus far collected would indicate.

Acknowledgment is due Commander H. E. Saunders for the map (page 475) of King Edward VII Land and northwestern Marie Byrd Land, which was drawn from the reconnaissance map now in preparation by him. The map was constructed from aerial photographs and ground-control survey made by the Marie Byrd Land Sledging Party, the route of which is shown. Shaded portions are conjectured edges of the land mass and should not be considered definite.

Explanation of Plate

PLATE 32

Fig. 1. General view of Edsel Ford Ranges of northwestern Marie Byrd Land as seen in an aerial photograph taken above northeastern exposures of Haines Mts., showing route of Sledging Party.

Fig. 2. Mt. Helen Washington lying on the southern side of King Edward VII Land, as seen from the air. A rookery of snowy petrel was found on the peak in the foreground, and all plant specimens were taken from this area.

Fig. 3. Mt. Helen Washington. A closer view of the southernmost peak on which the snowy petrel rookery was found. A line of lower limit of plant growth is visible. Lack of growth below this line is probably due to recent recession of ice, and concentrated plant growth just above it is probably due to the greater supply of moisture trickling down the mountain side.

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SECOND BYRD ANTARCTIC EXPEDITION

EXPLANATION OF PLATE

PLATE 33

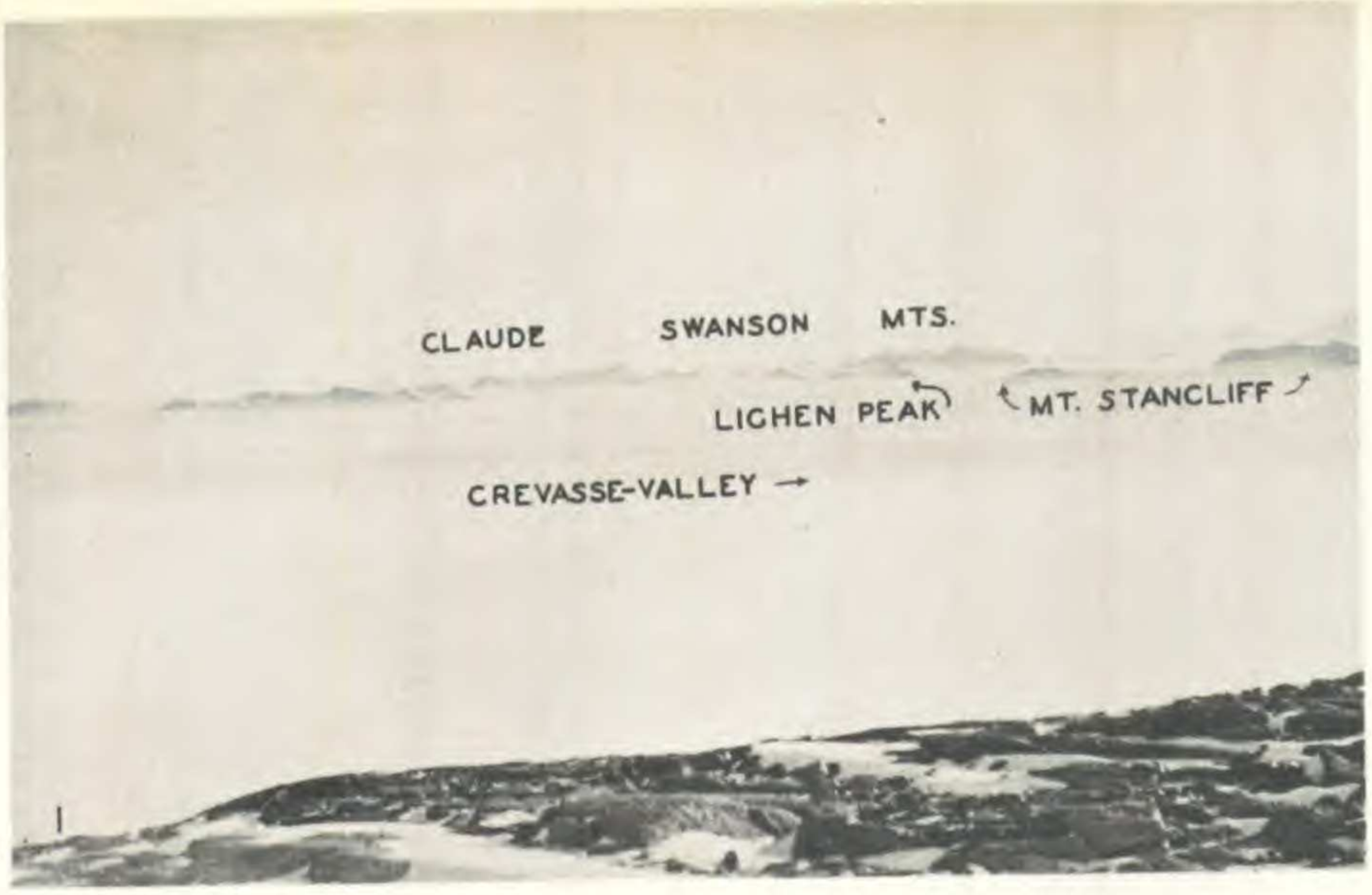
Fig. 1. Claude Swanson Mts. A view of numerous peaks lying 25 miles south of Chester Mts., of which only the two most northern ones have been visited.

Fig. 2. Mt. Grace McKinley. Strange depressions probably formed by wind erosion in weak portions of coarse-grained leucogranite are catchment basins for snow which melts to form a water supply for *Alectoria antarctica.*

Fig. 3. Mt. Rea-Cooper. Plant life decorates rocks as raisins in a pudding. Slow melting of snow in such depressions is a water supply during growing periods.

Fig. 4. Haines Mts. A northeastern exposure showing location of outcrops too perilous for collecting specimens.

Fig. 5. Mt. Helen Washington. A snowy petrel egg lying in sheltered retreat between rocks. Guano enriches the growth of lichens which may be seen on weathered coarse-grained granite. (Photo of O. D. Stancliff.)



SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 34

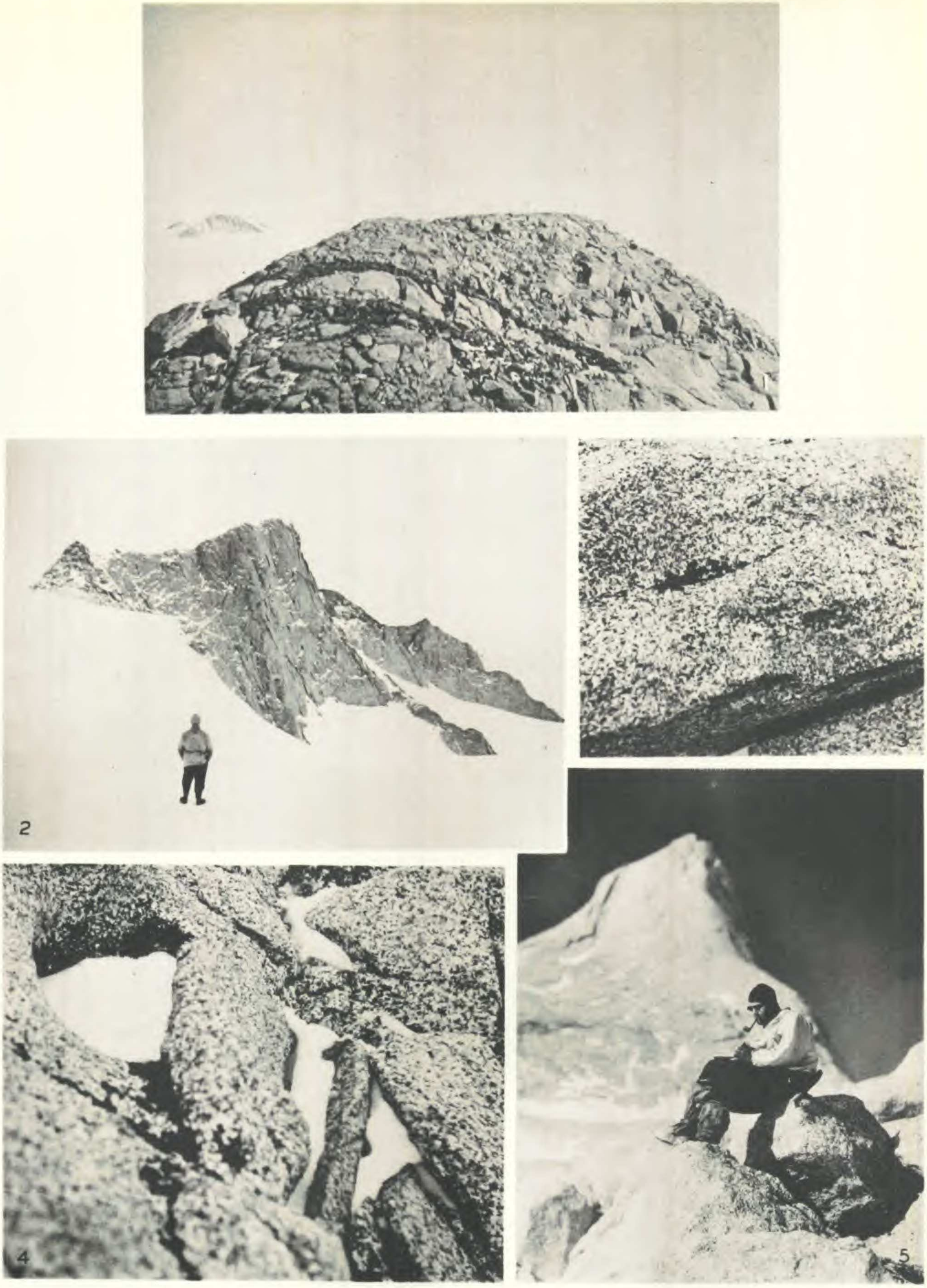
Fig. 1. Mt. Rea-Cooper. View facing southwest, with Mt. Donald Woodward to the left and Haines Mts. in central distance. In foreground is a knob of igneous rock with stoped inclusions of schists of sedimentary origin.

Fig. 2. Mt. Grace McKinley. View taken about a mile to the northeast. North face of mountain is sheer cliff, while south slope is more gentle and snow covered. Only approachable area for collection is along precarious upper edge of cliff.

Fig. 3. Mt. Grace McKinley. Small isolated patches of *Usnea* and *Alectoria* growing on coarse leucogranite.

Fig. 4. Mt. Grace McKinley. Small structural hollows form catchment basins for snow which melts slowly and forms the water supply for plant growth. Plants are mostly *Alectoria*.

Fig. 5. Mt. Rea-Cooper. F. Alton Wade, geologist, sitting on one of the boulders of the talus slope on the west side of Mt. Cooper. Note small isolated patches of plant life on the rocks, a common characteristic. Such plants receive little moisture and are seldom large. (Photo of O. D. Stancliff.)



SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

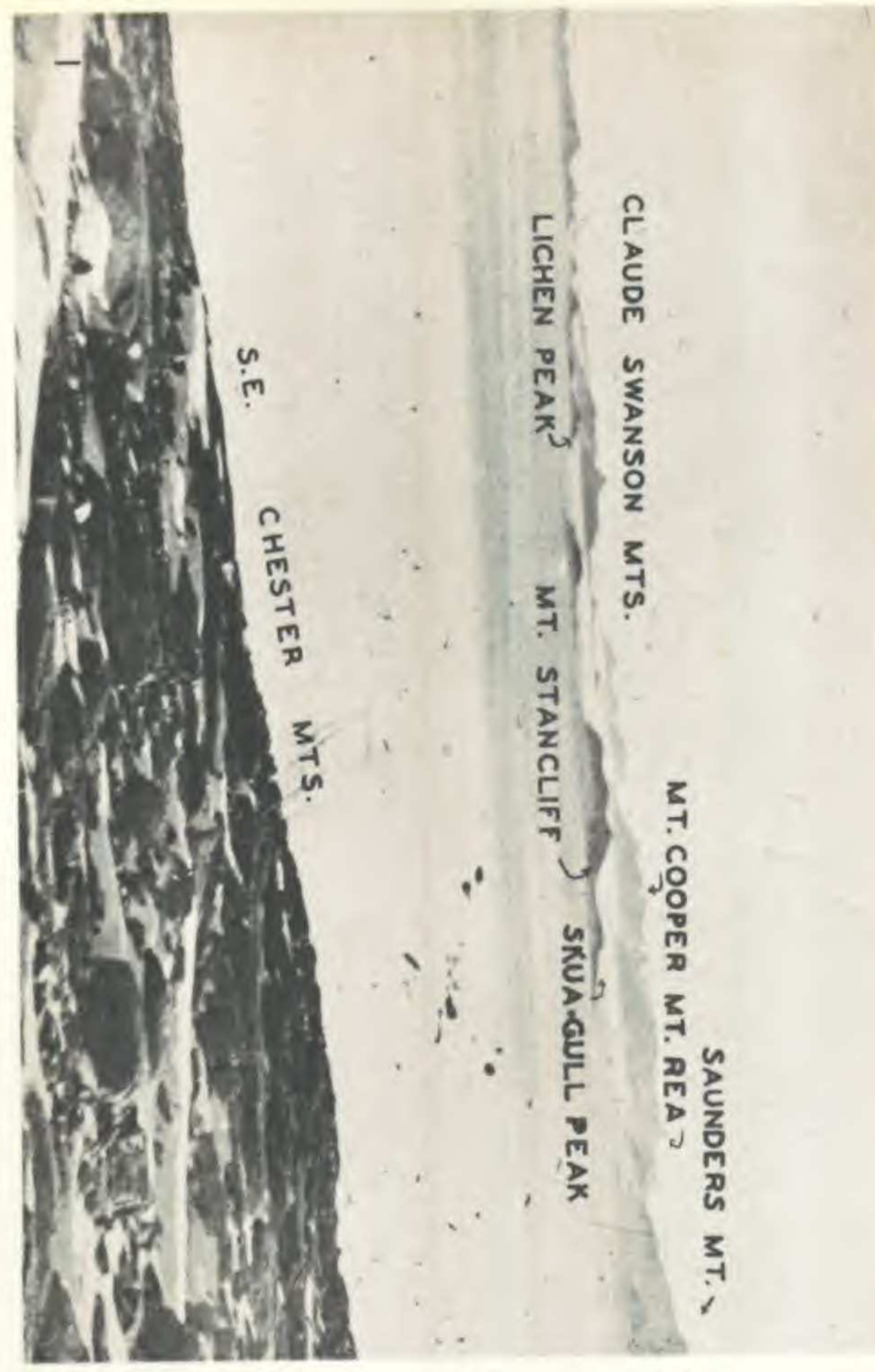
PLATE 35

Fig. 1. Mt. Stancliff, seen looking southwest from Chester Mts. Mt. Stancliff is encircled by other mountains and enjoys the richest flora, amounting to nearly 50 species of lichens and mosses.

Fig. 2. Skua Gull Peak, with the loftier parts of Mt. Stancliff rising in the background to the east. The pond nestled in the top of this peak remains unfrozen during the summer and is abundant in microscopic life. Skua gulls visit it periodically, probably as a resting place. Mosses and lichens are abundant all about this sheltered pond. Note the growths on the rock in the foreground.

Fig. 3. Mt. Rea-Cooper. Talus slope which supports most of the plant life found on this mountain. About two miles away is the sheerest cliff of Mt. Rea, nicknamed "Billboard" because of its appearance.

Fig. 4. Skua Gull Peak. A crest view showing a drier area almost free of snow in early summer. Plant life here becomes sparser due to lack of available moisture, but is common in cracks. The flat spreading *Lecanora* may be seen on the vertical faces in the left foreground.



SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 36

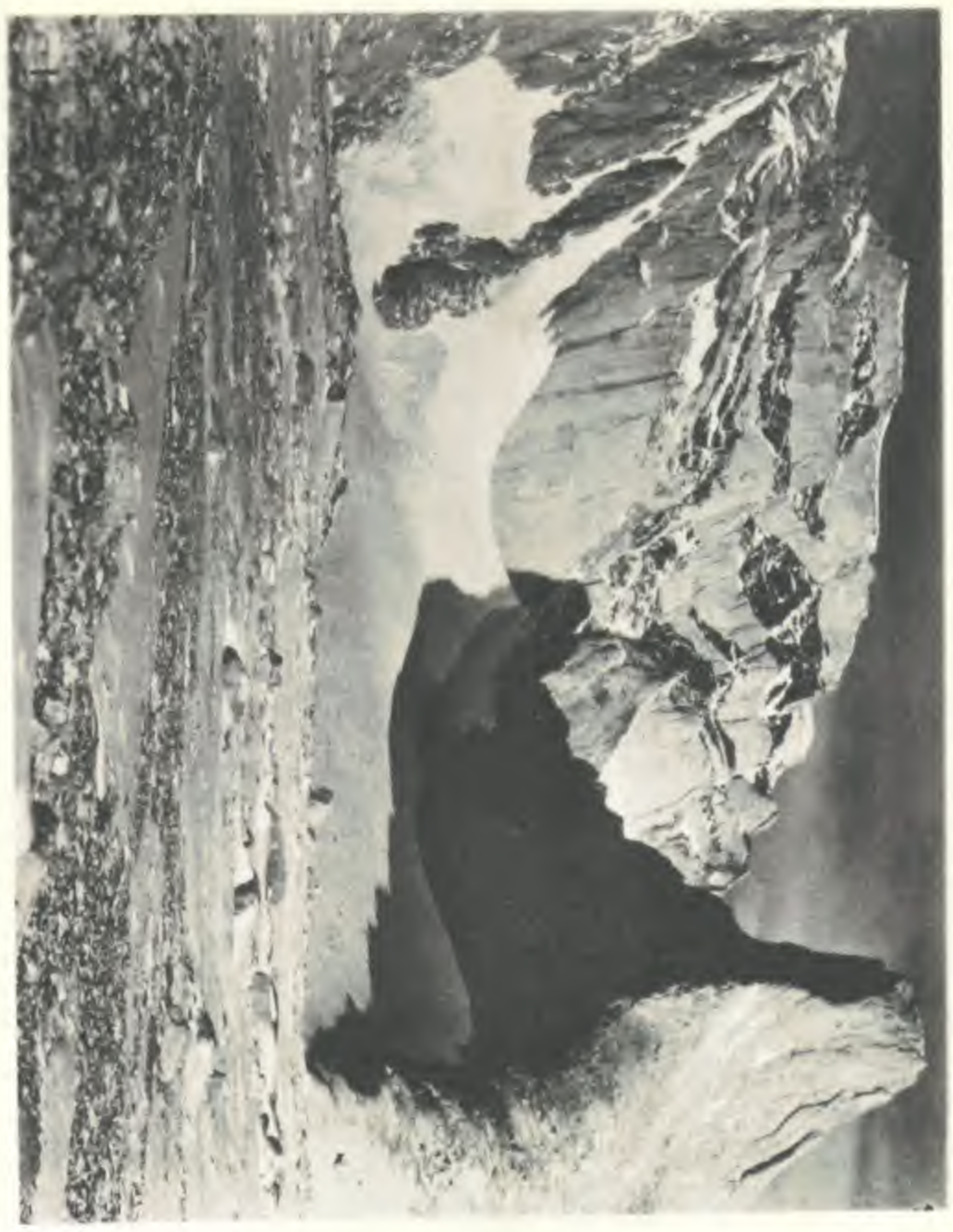
Fig. 1. Mt. Rea-Cooper. General aspect of the sheer cliffs at the northern end of Mt. Cooper, several of which were nearly 1000 ft. high. Morainic material and talus were best collecting grounds. This picture was taken nearly a mile to the west of the mountain. Note the stoped blocks of shists in the granite rock mass. (Photo of O. D. Stancliff.)

Fig. 2. Skua Gull Peak. An area of typical abundant growth of plants on dark metamorphic sediments. Note the flat sloping rock surface which permits a trickle of water from snow above, also the accumulation of plant growth in cracks and hollows. The broad patch in the center toward which the forcep handle is pointing is the conspicuous red branching *Gasparrinia Siplei.*

Fig. 3. Mt. Rea-Cooper. General appearance of lichen growths grouped together on coarse leucogranite. Note the plants on the small rocks. As many as ten species were found on a single stone. (Photo of O. D. Stancliff.)

Fig. 4. Scudder Mt. near Organ Pipes, Queen Maud Range. Most southerly plant life so far collected, 237 nautical miles from the South Pole. (Photo of R. S. Russell, Jr.)

Fig. 5. Mt. Donald Woodward. An encampment of the Marie Byrd Land Sledging Party about a quarter of a mile from the mountain. A wind moat lies between camp and base of the mountain. Note the blackness of metamorphic sedimentary schists.



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SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 37

Fig. 1. Mt. Corey, looking north toward volcano and Raymond Fosdick Mts. Dark rocks to left are remnants of the cone, and higher peaks in background are granites and gneisses. No plants found at that point. In the foreground is an ice-polished dome of Mt. Corey which supports sparse vegetation.

Fig. 2. Queen Maud Mts. View of Organ Pipes as seen from Scudder Mt. where most southerly lichens were collected. In front, Richard S. Russell, Jr., one of the members of Queen Maud Geological Party.

Fig. 3. Mt. Rea. Moss clumps and lichens grouped along a miniature drainage line.

Fig. 4. Mt. Donald Woodward. Appearance of north face of mountain from about a mile away.

Fig. 5. Chester Mts. Typical rocky surface which supported moderate growths of mosses and lichens. This is southeast exposure with Raymond Fosdick Mts. to northeast.